

Hypoxia Capstone Meeting Minutes 9/8/20

- Team Recorder: Alex Morrison
 - Team Name: HYPEngineers?
 - Ian Glasgow: team mentor, will give machine shop training and assist with some design help.
 - Instructor: Dr. Dev Shrestha
 - Agenda creator: Colin
 - Weekly meetings: Thursdays at 3:30pm with Dr. Shrestha, and Friday at 2:45pm. Will discuss whether to meet in person (and where) or on Zoom on a case by case basis, but will meet on Zoom until a room is found.
 - Client: Dr. Nathan Schiele
 - Finances and budgeting: Izzie
 - Documentation: Jacob
 - Main client contact: Colin
 - Meeting coordinator: Andrew
-
- Discord: <https://discord.gg/vRFz9k>

Hypoxia Capstone Meeting Minutes 9/11/20

- Questions for Dr. Schiele
 - Why are we doing this?
 - What will the chamber be used for – what specific research are you hoping to accomplish with it?
 - Are we building just a controller or a chamber as well?
 - If it is the chamber as well, does it need to maintain the temp/humidity environment or will that be regulated by some other device.
 - What does the budget look like?
 - Do you have some of the materials or is this a project from scratch?
 - How would a device maintain Oxygen and CO2 levels?
 - Do you have an ideas for how you would like the human interface to function?
 - On device controls, link to a computer, etc.
 - Are controllers such as the [ProOx C21](#) good examples of what we're trying to design?
 - How frequently should the sensor be polled/recorded for logging data?
 - Have you done research into what sensors or hardware to use for the project within budget?
- Final report would likely be just working on the open source paper, hopefully to be done by May
 - Used Open Science?? to submit
 - Have one team member understand the formatting necessary for the paper and take the lead on that
- Use a nitrogen-controlled device to remove the oxygen
- Don't need a separate device to control CO2, the incubators do that by pumping in the gas
- Building a new chamber that would control the hypoxia levels and must still maintain the CO2 levels and other environment of the incubator
- Budget – less than \$1000
 - Need to price out components
 - Try to balance using parts that other labs would typically have versus manufacturing our own parts
- GUI setup – either real buttons or hooking up a computer to use software (using computers can cause issues with networks or be cost limiting)
 - Would like a physical data interface such as rs232 or something else for data communication?
- Hypoxia can activate hif1 alpha factor – this may induce production of lysol oxidase (causes cross linking of collagen = stronger tendon)

- Currently: use cobalt chloride to mimic hypoxia response, but long term this can cause cell death, and is not realistically “natural”
- Hardware x opensource paper withing university computers

Hypoxia Capstone Meeting Minutes 9/16/20

- Quick review of which questions were asked/answered from Dr. Schiele last week
- Someone will need to take the CSWA exam to get a license for SolidWorks
 - Will take 3 hours, can get prep help from Ian
 - Need to see if we feel that it's necessary
- Project deadlines excel was created, for us to view both team and individual goals and when they must be completed
- Excel sheet for possible products was created for us to use as we determine which sensors/etc. to use for the project
 - Sensors need to be wiped down with alcohol or autoclaved in the incubator
 - Arduino might be the best controller system, multiple people have some experience with it
- Budget planning
- Product Requirement Document
 - Izzie – Objective, Environmental Requirements
 - Andrew – Software Requirements, Electrical Requirements
 - Alex – Electrical Requirements
 - Colin – Scope, Regulatory Requirements, Functional Requirements
 - Jacob – Mechanical Requirements, Cost Requirements

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148923>

Hypoxia Capstone Meeting Minutes 9/17/20

- Went over deadlines Excel with Dr. Shrestha
- Went over Possible Projects Excel
 - May want to have a CO2 sensor inside the chamber to monitor the levels inside to ensure they match the incubator levels
 - Should check on this with Dr. Schiele
- Went over Budgeting Excel
 - Confirmed that it makes sense to order parts early, so that we can test them out early on
 - Add ~\$200 for graduate student fees
- Oxygen sensors --
 - Possibility of enclosing sensor somehow within the chamber so that it doesn't need to be cleaned with alcohol (as this would likely break the sensor)
 - Many sensors don't list their prices outright, need to actually ask for them
 - <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0148923>
 - Article will help lots in regards to figuring out how to use the sensors with a control system such as an Arduino
- Chamber itself will likely have to be metal or acrylic to withstand conditions
 - <https://onlinelibrary.wiley.com/doi/full/10.1002/mds3.10064>
- Solidworks license
 - Someone must pass CSWA to get license, unsure if this is needed
 - OnShape is a free online resource for students that is similar, the only drawback is whatever we work on there will be in the public domain
- Tasks
 - Work on Product Requirements Document and Product Schedule

Hypoxia Capstone Meeting Minutes 9/18/20

- Went over Product Requirements Document
 - Unsure of what to do about References, since we don't seem to have standards
 - Functional Requirements should be a very general overview of what we want the finished product to do
- Questions for Dr. Schiele
 - Need a time to measure the incubator
 - Should also double-check desired weight
 - Unsure if monitoring Co₂, humidity, and temperature are desired for the finished product or if they should just be part of the development
 - Should the chamber be airtight?
 - If so, we'll have to specifically control the Co₂ and humidity levels
 - If not, we'll essentially have to turn the whole incubator into a hypoxic environment
- Everyone should try to find 1-2 papers concerning our project so that we have more research to pull from
- The Product Requirements Document should be finished by next meeting

Hypoxia Capstone Meeting Minutes 9/24/20

- Shown example of an old logbook
 - Cross out empty space on pages for legal reasons, to show that backfilling was prevented
- Explained Product Requirements document to Dr. Shrestha
 - For weight, attempt to hit all requirements while trying to keep it as light as possible
 - Shelves inside the incubator can't hold more than 22lbs.
- Debate on whether it should be airtight
 - Possibility of adding a way to exchange the air inside/outside the incubator/chamber to help adjust humidity/temperature
- Oxygen sensor might need to be covered by cloth or housed separately so that the chamber can be cleaned.
 - This will affect how quickly the sensor can read the oxygen levels, so we're sacrificing response time for sanitation
- A way to log data would be nice, but isn't first priority. Possibly a project for next semester, once we have a working prototype
- Balance time with saving money. Don't spend 2 days trying to save \$20. Going over budget a bit is okay.
- Goal for Oct 13 (Snapshot 1):
 - Having a 3D model of our design
 - Dr. Shrestha recommends having some physical way to represent our project, either simply using a cardboard box to demonstrate the idea or 3D printing something
 - Make something that we can show fitting the well plates inside, and possibly have the components of the control system wired up just to show our idea
- Need to split up a bit – have someone work with Ian to design the chamber, Andrew & Alex can work on refining the control system a bit more
- Design doesn't have to be all glass/acrylic, bottom could be metal, or wooden blocks could be used as the "corners" with the glass panes slid into them to add stability
 - Need to make sure all materials are safe to use in a hypoxic environment

Action Items

Andrew – Sensor and ways to house it that reduce contamination and allow cleaning

Jacob – rough sketch of the chamber

Colin – Start a possible design of the chamber in 3d modeling software, as well as looking into the materials that could be used for the chamber.

Isabell – Investigate materials and what are safe options for the chamber

Alex – Work on control system housing and the sensor wiring

Hypoxia Capstone Meeting Minutes 9/25/20

- For housing the oxygen sensor: it's possible to 3D print a housing for the sensor within the chamber, and then use a filter (such as the ones from the flasks). This way the filter and housing could be cleaned, but the sensor itself would be protected. Oxygen could still flow through to the sensor, and contaminants would not be able to affect the main chamber
- Ian's logbook
 - Make sure any printed items are laid flat
 - Make sure each page is filled completely
- Design ideas
 - Make two pieces and use an O-ring to get the seal
 - Trying to think of 1-step manufacturing ideas
 - Use 3D printed brackets, then slide in laser-cut acrylic
 - Need a release valve to get rid of the extra oxygen/nitrogen in the chamber without releasing directly into the incubator (pressure regulator valve -- \$200)
 - Need a way to make chamber have humidity— leave a cup of sterile water
 - How to deal with gases -
 - Other projects have used a mixture of 1% oxygen, 5% CO₂, and 94% nitrogen, but this was premixed by another company (no idea how expensive it is)
 - This path could be detrimental because we'd need different mixtures for varying oxygen levels
- For snapshot
 - Get box dimensions, manufacture a quick test box
- For meetings, split up the time so that everyone has to talk about what they did each week, to make sure that everyone is pulling their own weight